RECORDING MEDIUM HAVING DATA STRUCTURE FOR MANAGING REPRODUCTION OF MULTIPLE REPRODUCTION PATH VIDEO DATA RECORDED THEREON AND RECORDING AND REPRODUCING METHODS AND APPARATUSES

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a recording medium having a data structure for managing reproduction of at least multiple reproduction path video data recorded thereon as well as methods and apparatuses for reproduction and recording.

Description of the Related Art

[0002] The standardization of new high-density read only and rewritable optical disks capable of recording large amounts of high-quality video and audio data has been progressing rapidly and new optical disk related products are expected to be commercially available on the market in the near future. The Blu-ray Disc Rewritable (BD-RE) is one example of these new optical disks.

[0003] Fig. 1 illustrates the file structure of the BD-RE. The file structure or data structure provides for managing the reproduction of the video and audio data recorded on the BD-RE. As shown, the data structure includes a root directory that contains at least one BDAV directory. The BDAV directory includes files such as 'info.bdav', 'menu.tidx', and 'mark.tidx',

a PLAYLIST subdirectory in which playlist files (*.rpls and *.vpls) are stored, a CLIPINF subdirectory in which clip information files (*.clpi) are stored, and a STREAM subdirectory in which MPEG2-formatted A/V stream clip files (*.m2ts) corresponding to the clip information files are stored. In addition to illustrating the data structure of the optical disk, Fig. 1 represents the areas of the optical disk. For example, the general information file info.bdav is stored in a general information area or areas on the optical disk.

[0004] Because the BD-RE data structure and disk format as illustrated in Fig. 1 is well-known and readily available, only a brief overview of the file structure will be provided in this disclosure.

[0005] As alluded to above, the STREAM directory includes MPEG2-formatted A/V stream files called clips or clip files. The STREAM directory may also include a special type of clip referred to as a bridge-clip A/V stream file. A bridge-clip is used for making seamless connection between two or more presentation intervals selected in the clips, and generally have a small data size compared to the clips. The A/V stream includes source packets of video and audio data. For example, a source packet of video data includes a header and a transport packet. A source packet includes a source packet number, which is generally a sequentially assigned number that serves as an address for accessing the source packet. Transport packets include a packet identifier (PID). The PID identifies the sequence of transport packets to which a transport packet belongs. Each transport packet in the sequence will have the same PID.

[0006] The CLIPINF directory includes a clip information file associated with each A/V stream file. The clip information file indicates, among other things, the type of A/V stream associated therewith, sequence information, program information and timing information. The sequence information describes the arrival time basis (ATC) and system time basis (STC) sequences. For example, the sequence information indicates, among other things, the number of sequences, the beginning and ending time information for each sequence, the address of the first source packet in each sequence and the PID of the transport packets in each sequence. A sequence of source packets in which the contents of a program is constant is called a program sequence. The program information indicates, among other things, the number of program sequences, the starting address for each program sequence, and the PID(s) of transport packets in a program sequence.

[0007] The timing information is referred to as characteristic point information (CPI). One form of CPI is the entry point (EP) map. The EP map maps a presentation time stamp (e.g., on an arrival time basis (ATC) and/or a system time basis (STC)) to a source packet address (i.e., source packet number). The presentation time stamp (PTS) and the source packet number (SPN) are related to an entry point in the AV stream; namely, the PTS and its related SPN point to an entry point on the AV stream. The packet pointed to is often referred to as the entry point packet.

[0008] The PLAYLIST directory includes one or more playlist files. The concept of a playlist has been introduced to promote ease of

editing/assembling clips for playback. A playlist file is a collection of playing intervals in the clips. Each playing interval is referred to as a playitem. The playlist file, among other things, identifies each playitem forming the playlist, and each playitem, among other things, is a pair of IN-point and OUT-point that point to positions on a time axis of the clip (e.g., presentation time stamps on an ATC or STC basis). Expressed another way, the playlist file identifies playitems, each playitem points to a clip or portion thereof and identifies the clip information file associated with the clip. The clip information file is used, among other things, to map the playitems to the clip of source packets.

[0009] A playlist directory may include real playlists (*.rpls) and virtual playlists (*.vpls). A real playlist can only use clips and not bridge-clips. Namely, the real playlist is considered as referring to parts of clips, and therefore, conceptually considered equivalent in disk space to the referred to parts of the clips. A virtual playlist can use both clips and bridge-clips, and therefore, the conceptual considerations of a real playlist do not exist with virtual playlists.

[0010] The info.bdav file is a general information file that provides general information for managing the reproduction of the A/V stream recorded on the optical disk. More specifically, the info.bdav file includes, among other things, a table of playlists that identifies the file names of the playlist in the PLAYLIST directory of the same BDAV directory.

[0011] The menu.tidx, menu.tdt1 and menu.tdt2 files store information related to menu thumbnails. The mark.tidx, mark.tdt1 and

mark.tdt2 files store information that relates to mark thumbnails. Because these files are not particularly relevant to the present invention, they will not be discussed further.

[0012] The standardization for high-density read-only optical disks such as the Blu-ray ROM (BD-ROM) is still under way. An effective data structure for managing reproduction of video and audio data recorded on the high-density read-only optical disk such as a BD-ROM is not yet available.

SUMMARY OF THE INVENTION

[0013] The recording medium according to the present invention includes path management information for managing the reproduction of at least multiple reproduction path video data (e.g., different camera angles of video data).

[0014] In one exemplary embodiment, the recording medium includes one or more management areas storing path change information. The path change information indicates where changes in reproducing at least one of the reproduction paths of video data are permitted. For example, in one exemplary embodiment, the path change information includes one or more flags associated with each reproduction path of video data. Each flag indicates whether and where a change in reproducing the associated reproduction path of video data is permitted.

[0015] In an exemplary embodiment, the path change information includes at least one entry point map associated with each

reproduction path. Each entry point map identifies entry points in the video data for the associated reproduction path and includes at least one flag. Each flag is associated with an entry point and identifies whether a change in reproduction path is permitted in relation to the entry point.

[0016] According to a further embodiment of the present invention, the flags permitting a change in a same associated reproduction path define one or more units of video data, and at least a portion of the video data recorded on the recording medium is multiplexed on a unit of video data basis.

[0017] The present invention further provides apparatuses and methods for recording and reproducing the data structure according to the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The above features and other advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

[0019] Fig. 1 illustrates the prior art file or data structure of a rewritable optical disk according to the Blu-ray Disc Rewritable (BD-RE) standard;

[0020] Figs. 2 illustrates an exemplary embodiment of a recording medium file or data structure according to the present invention;

[0021] Fig. 3 illustrates an example of a recording medium

having the data structure of Fig. 2 stored thereon;

[0022] Figs. 4 - 6 illustrate embodiments of the data structure associated with reproduction path management for use in the data structure according to Fig. 2;

[0023] Fig. 7 illustrates the time alignment that may exist between the entry point maps for the different clip files in the embodiments of the present invention; and

[0024] Fig. 8 illustrates a schematic diagram of an embodiment of an optical disk recording and reproduction apparatus of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0025] In order that the invention may be fully understood, preferred embodiments thereof will now be described with reference to the accompanying drawings.

[0026] A high-density optical disk, for example, a Blu-Ray ROM (BD-ROM), BD-RE, etc. in accordance with the invention may have a file or data structure for managing reproduction of video and audio data as shown in Fig. 2. Many aspects of the data structure according to the present invention shown in Fig. 2 are similar to that of the BD-RE standard discussed with respect to Fig 1. As such these aspects will not be described in great detail.

[0027] As shown in Fig. 2, the root directory contains at least one DVP directory. The DVP directory includes a general information file

info.dvp, menu files menu.tidx, menu.tdt1 among others, a PLAYLIST directory in which playlist files (e.g., real (*.rpls) and virtual (*.vpls)) are stored, a CLIPINF directory in which clip information files (*.clpi) are stored, and a STREAM directory in which MPEG2-formatted A/V stream clip files (*.m2ts), corresponding to the clip information files, are stored.

[0028] The STREAM directory includes MPEG2-formatted A/V stream files called clips or clip files. The A/V stream includes source packets of video and audio data. For example, a source packet of video data includes a header and a transport packet. A source packet includes a source packet number, which is generally a sequentially assigned number that serves as an address for accessing the source packet. Transport packets include a packet identifier (PID). The PID identifies the sequence of transport packets to which a transport packet belongs. Each transport packet in the sequence will have the same PID.

[0029] The CLIPINF directory includes a clip information file associated with each A/V stream file. The clip information file indicates, among other things, the type of A/V stream associated therewith, sequence information, program information and timing information. The sequence information describes the arrival time basis (ATC) and system time basis (STC) sequences. For example, the sequence information indicates, among other things, the number of sequences, the beginning and ending time information for each sequence, the address of the first source packet in each sequence and the PID of the transport packets in each sequence. A sequence of source

packets in which the contents of a program is constant is called a program sequence. The program information indicates, among other things, the number of program sequences, the starting address for each program sequence, and the PID(s) of transport packets in a program sequence.

[0030] The timing information is referred to as characteristic point information (CPI). One form of CPI is the entry point (EP) map. The EP map maps a presentation time stamp (e.g., on an arrival time basis (ATC) and/or a system time basis (STC)) to a source packet address (i.e., source packet number). The presentation time stamp (PTS) and the source packet number (SPN) are related to an entry point in the AV stream; namely, the PTS and its related SPN point to an entry point on the AV stream. The packet pointed to is often referred to as the entry point packet.

[0031] The PLAYLIST directory includes one or more playlist files. The concept of a playlist has been introduced to promote ease of editing/assembling clips for playback. A playlist file is a collection of playing intervals in the clips. Each playing interval is referred to as a playitem. The playlist file, among other things, identifies each playitem forming the playlist, and each playitem, among other things, is a pair of IN-point and OUT-point that point to positions on a time axis of the clip (e.g., presentation time stamps on an ATC or STC basis). Expressed another way, the playlist file identifies playitems, each playitem points to a clip or portion thereof and identifies the clip information file associated with the clip. The clip information file is used, among other things, to map the playitems to the clip of source packets.

[0032] A playlist directory may include real playlists (*.rpls) and virtual playlists (*.vpls). A real playlist can only use clips and not bridge-clips. Namely, the real playlist is considered as referring to parts of clips, and therefore, conceptually considered equivalent in disk space to the referred to parts of the clips. A virtual playlist can use both clips and bridge-clips, and therefore, the conceptual considerations of a real playlist do not exist with virtual playlists.

[0033] The info.dvp file is a general information file that provides general information for managing the reproduction of the A/V streams recorded on the optical disk. More specifically, the info.dvp file includes, among other things, a table of playlists that identifies the file names of the playlists in the PLAYLIST directory. The info.dvp file will be discussed in greater detail below with respect to the embodiments of the present invention.

[0034] In addition to illustrating the data structure of the recording medium according to an embodiment of the present invention, Fig. 2 represents the areas of the recording medium. For example, the general information file is recorded in one or more general information areas, the playlist directory is recorded in one or more playlist directory areas, each playlist in a playlist directory is recorded in one or more playlist areas of the recording medium, etc. Fig. 3 illustrates an example of a recording medium having the data structure of Fig. 2 stored thereon. As shown, the recording medium includes a file system information area, a data base area and an A/V stream area. The data base area includes a general information file and

playlist information area and a clip information area. The general information file and playlist information area have the general information file recorded in a general information file area thereof, and the PLAYLIST directory and playlist files recorded in a playlist information area thereof. The clip information area has the CLIPINFO directory and associated clip information files recorded therein. The A/V stream area has the A/V streams for the various titles recorded therein.

[0035] Video and audio data are typically organized as individual titles; for example, different movies represented by the video and audio data are organized as different titles. Furthermore, a title may be organized into individual chapters in much the same way a book is often organized into chapters.

[0036] Because of the large storage capacity of the newer, high-density recording media such as BD-ROM and BD-RE optical disks, different titles, various versions of a title or portions of a title may be recorded, and therefore, reproduced from the recording media. For example, video data representing different camera angles may be recorded on the recording medium. As another example, versions of title or portions thereof associated with different languages may be recorded on the recording medium. As a still further example, a director's version and a theatrical version of a title may be recorded on the recording medium. Or, an adult version, young adult version and young child version (i.e., different parental control versions) of a title or portions of a title may be recorded on the recording medium. Each version,

camera angle, etc. represents a different reproduction path, and the video data in these instances is referred to as multiple reproduction path video data. It will be appreciated that the above examples of multiple reproduction path video data are not limiting, and the present invention is applicable to any type or combination of types of multiple reproduction path video data. As will be described in detail below with respect to embodiments of the present invention, the data structures according to the present invention include path management information and/or navigation information for managing reproduction of multiple reproduction path video data recorded on the recording medium.

[0037] A first embodiment of the reproduction path management information for use in the data structure according to Fig. 2 will now be described with respect to Fig. 4. According to this embodiment, the multiple reproduction path data is recorded in a plurality of clip files such that each clip files is associated with one of the reproduction paths. The clip files in this embodiment are recorded on the recording medium in a non-interleaved fashion. Fig. 4 illustrates an exemplary clip file corresponding to a reproduction path according to this embodiment of the present invention. As shown, the clip file is divided into a plurality of entry points (EPs), which are referenced in an EP map of an associated clip information file. The entry points are group into units referred to as jumping units, for example, jumping units JU#1, JU#2 and JU#3 shown in Fig. 4. During reproduction, changing between reproduction paths occurs on a

jumping unit basis. Namely, upon receipt of a reproduction path change request from a user, reproduction of the currently reproduced jumping unit is completed, and reproduction then continues at the beginning of a jumping unit in a clip file associated with the newly requested reproduction path.

[0038] As further shown in Fig. 4 with respect to the last entry point in the first jumping unit JU#1, the last picture of video data in the last entry point of each jumping unit is restricted to being a P-picture or B-picture. And, if the last picture is a B-picture, the last picture is restricted to refer to a preceding P-picture without referring to a following I-picture included in a subsequent entry point.

[0039] Also, auxiliary data, for example, audio data, associated with the video data corresponding to the last entry point of the first jumping unit, is recorded in a state of being multiplexed with the video data. In this case, the trailing end of the entry point is recorded with only the audio data, which has a low recording bit rate, without being recorded with the video data which has a high recording bit rate. For this reason, bandwidth loss of recording bit rate occurs.

[0040] Fig. 4 further shows, with respect to the first entry point in the second jumping unit JU#2, that the first picture of video data in the starting entry point of each jumping unit is restricted to being an I-picture or B-picture. And, if the first picture is a B-picture, the first picture is restricted to refer to a following I-picture without referring to a preceding P-picture included in a previous entry point. In this case, a flag "Closed_gop = 1" may be

recorded in a GOP (Group Of Pictures) header of the entry point indicating that the entry point begins with a closed GOP. Namely, each jumping unit begins with a closed GOP.

[0041] Also, auxiliary data, for example, audio data, associated with the video data corresponding to the starting entry point of a jumping unit is recorded in a state of being multiplexed with the video data. In this case, the leading end of the entry point is recorded with only the video data, which has a high recording bit rate, without being recorded with the audio data which has a low recording bit rate. For this reason, a small quantity of bandwidth loss of recording bit rate occurs.

[0042] As further shown in Fig 4 with respect to middle entry points in the second jumping unit JU#2, each B-picture of video data in the middle entry points of each jumping unit refers to preceding and following I or P-pictures, irrespective of a boundary between entry points.

[0043] Also, the video data corresponding to each entry point, and the auxiliary data, for example, audio data, associated with the video data are recorded in a state of being multiplexed with each other. When the multiplexing of the video data corresponding to one entry point with the associated audio data is completed under the condition in which there remains a part of the associated audio data not multiplexed with the video data, this residual non-multiplexed audio data is recorded while being multiplexed with the video data corresponding to the next entry point. Accordingly, there is no occasion that video data or audio data is recorded

alone. Thus, there is no bit bandwidth loss.

[0044] In accordance with the present invention, it is possible to minimize the total bandwidth loss of the recording bit rate for each jumping unit because, even though there is bandwidth loss of the recording bit rate in the leading end of the starting entry point in each jumping unit and the trailing end of the last entry point in each jumping unit, there is no bandwidth loss of the recording bit rate in the other entry points.

[0045] Management of entry points may be carried out in such a fashion that one entry point is managed by one jumping unit. In this case, however, increased bandwidth loss of the recording bit rate occurs because video data is recorded alone in the leading portion of each entry point and audio data is recorded alone in the trailing portion of each entry point, and the efficiency of recording data streams is greatly reduced.

[0046] Fig. 5 illustrates an embodiment of the present invention in which reproduction path change is carried out. Fig. 5 illustrates a plurality of clip files having the same format as described above with respect to Fig 4 except for certain differences described in detail below. As with Fig. 4, each clip file is associated with a different reproduction path. As shown in Fig 5, each clip file may be divided into a number of jumping units and each jumping unit JU is formed of a same predetermined number of entry points. However, as shown in Fig. 6 described below, the present invention is not limited to having jumping units with the same number of entry points. Instead each jumping unit may have the same or a different number of entry points. Each

entry point included in each jumping unit JU may have a variable time length. Accordingly, the time length of each jumping unit JU may be variable. However, in an alternative embodiment, each entry point may have the same fixed time length. Specifically, in Fig. 5, each of first through k-th clip files Clip file # 1 to Clip file #k respectively corresponding to first through k-th paths Path #1 to Path #k and are divided into first through fourth jumping units JU #1 to JU #4. Each jumping unit of each clip file includes N entry points.

[0047] When a path change to a particular path is requested during reproduction of, for example, the data streams of the entry points included in the second jumping unit JU #2 in the second clip file corresponding to the second path, as shown in Fig. 5, the second jumping unit JU #2 is completely reproduced through the data stream of the last entry point included therein. After the complete reproduction of the second jumping unit JU #2, the clip file of the particular path requested to be reproduced, for example, the k-th path, is searched for the starting entry point of the next jumping unit thereof. That is, the third jumping unit JU #3 f the k-th Clip file is searched. This clip file corresponding to the k-th path is successively reproduced in a jumped fashion, starting from the starting entry point of the third jumping unit JU #3.

[0048] Thus, the data streams of the second path and the data streams of the k-th path are successively reproduced in a seamless fashion in the unit of jumping units.

[0049] Fig. 6 illustrates an embodiment of the present invention

in which reproduction path change is carried out. Fig. 6 illustrates a plurality of clip files having the same format as described above with respect to Fig 4 except for certain differences described in detail below. As with Fig. 4, each clip file is associated with a different reproduction path. As shown in Fig 6, each clip file may be divided into a number of jumping units and each jumping unit JU is formed of a different number of entry points. However, as shown in Fig. 5 described above, the present invention is not limited to having jumping units with different numbers of entry points. Instead each jumping unit may have the same or a different number of entry points. Each entry point included in each jumping unit JU may have a variable time length. Accordingly, the time length of each jumping unit JU may be variable. However, in an alternative embodiment, each entry point may have the same fixed time length. Specifically, in Fig. 6, each of first through k-th clip files Clip file # 1 to Clip file #k respectively corresponding to first through k-th paths Path #1 to Path #k may be managed in a divided fashion by jumping units JU, for example, a first jumping unit JU #1 grouping K entry points, a second jumping unit JU #2 grouping N entry points, a third jumping unit JU #3 grouping M entry points, and a fourth jumping unit JU #4 grouping N entry points.

[0050] The entry point map in the clip information file associated with each clip file includes a jumping flag J_Flag associated with each entry point. Each jumping flag J_Flag indicates whether a change to another reproduction path is permitted, and if a change is permitted, the

jumping flag J_Flag implies the point in the clip file where the jump takes place in relation to the entry point.

[0051] More specifically, according to one exemplary embodiment of the present invention, a jumping flag "J_Flag = 1" indicates a change to reproducing a clip file associated with a different reproduction path is permitted (active jumping flag), and a jumping flag "J_Flag = 0" indicates that no change is permitted (inactive jumping flag). Furthermore, according to one exemplary embodiment, when the jumping flag indicates that a change is permitted, the jumping flag implies that the change is permitted after reproduction of the entry point with which the jumping flag is associated.

[0052] According to another exemplary embodiment of the present invention as shown in Fig. 6, the jumping flags define the boundaries between jumping units. Namely, as shown in Fig 6, the entry point having an active jumping flag is the last entry point in a jumping unit, and the next entry point is the first entry point in the next jumping unit.

[0053] When a path change to a particular path is requested during reproduction of, for example, the data streams of the entry points included in the second jumping unit JU #2 in the second clip file corresponding to the second path, as shown in Fig. 6, respective jumping flags of the entry points included in the second jumping unit JU #2 are identified. The data streams of the second jumping unit JU #2 are reproduced up through the data stream of the entry point identified to include a jumping flag "J_Flag = 1", that is, the last entry point in the jumping unit JU#2. Thus, the

second jumping unit JU #2 is completely reproduced up through the data stream of the last entry point thereof.

[0054] After the complete reproduction of the second jumping unit JU #2, the clip file of the particular path requested to be reproduced, for example, the k-th path, is searched for the starting entry point of the next jumping unit thereof, that is, the third jumping unit JU #3 thereof. Namely, the first entry point following the entry point with an active jumping flag in the second jumping unit JU#2 of the k-th clip file is searched. The clip file corresponding to the k-th path is then successively reproduced in a jumped fashion, starting from the starting entry point of the third jumping unit JU #3.

[0055] Thus, the data streams of the second path and the data streams of the k-th path are successively reproduced in a seamless fashion in the unit of jumping units.

[0056] Alternatively, a successive reproduction in a jumped fashion, based on the jumping flags, may be achieved under the condition in which a jumping flag "J_Flag = 1" is recorded in the start entry point of each jumping unit JU, whereas a jumping flag "J_Flag = 0" is recorded in the other entry points of each jumping unit JU. In this embodiment, jumping from one reproduction path to another occurs at the point before the entry point with the active jumping flag.

[0057] Also, the above described clip files in the embodiments of the present invention may be recorded on the recording medium in an interleaved fashion, interleaved on a jumping unit basis. Alternatively, the clip

files may be recorded on separate physical recording areas of the recording medium.

[0058] Fig. 7 illustrates the time alignment that exists between the EP maps for the different clip files. As discussed, an EP map maps the presentation time stamp information to a source packet. More particularly, the presentation time stamp is mapped to the address or identifier of the source packet. The address or identifier is the source packet number (SPN). Fig. 7 further shows the source packets by source packet number along the presentation time stamp axis for each clip file 1, 2, and 3. As shown, source packets in each of the EP maps 1, 2, and 3 have the same presentation time stamps. For example, source packet x1 from the first clip file 1, source packet y1 from the second clip file 2 and source packet z1 from the third clip file 3 have the same presentation time stamp T1. As such, the EP maps 1, 2 and 3 are time-aligned. Because of this time-alignment, seamless reproduction of video data is possible even when the reproduction path is changed during reproduction. Fig. 7 illustrates changes in reproduction path by two concentric circles. As shown, if a user decides to change the reproduction path from clip file 2 to clip file 1 during reproduction of the second clip file 2 and a change is permitted after reproduction of source packet y2, then after completing reproduction of source packet y2, source packet x3 is the next source packet reproduced. Similarly if a user decides to change reproduction path (e.g., change camera angle to view) from clip file 1 to clip file 3 during reproduction of clip file 1 and a change is permitted after reproduction of the

source packet x4, then after completing reproduction of source packet x4, source packet z5 is reproduced. It will be understood that the source packet numbers given in the example above are merely exemplary, and that a source packet in one clip file will not, generally, have the same source packet number as a time aligned source packet in another clip file.

[0059] Fig. 8 illustrates a schematic diagram of an embodiment of an optical disk recording and reproducing apparatus according to the present invention. As shown, an AV encoder 9 receives and encodes audio and video data. The AV encoder 9 outputs the encoded audio and video data along with coding information and stream attribute information. A multiplexer 8 multiplexes the encoded audio and video data based on the coding information and stream attribute information to create, for example, an MPEG-2 transport stream. A source packetizer 7 packetizes the transport packets from the multiplexer 8 into source packets in accordance with the audio/video format of the optical disk. As shown in Fig. 8, the operations of the AV encoder 9, the multiplexer 8 and the source packetizer 7 are controlled by a controller 10. The controller 10 receives user input on the recording operation, and provides control information to AV encoder 9, multiplexer 8 and the source packetizer 7. For example, the controller 10 instructs the AV encoder 9 on the type of encoding to perform, instructs the multiplexer 8 on the transport stream to create, and instructs the source packetizer 7 on the source packet format. The controller 10 further controls a drive 3 to record the output from the source packetizer 7 on the optical disk.

[0060] The controller 10 also creates the navigation and management information for managing reproduction of the audio/video data being recorded on the optical disk. For example, based on information received via the user interface (e.g., instruction set saved on disk, provided over an intranet or internet by a computer system, etc.) the controller 10 controls the drive 3 to record the data structure of Figs. 2 and 4, 5 or 6 on the optical disk.

[0061] During reproduction, the controller 10 controls the drive 3 to reproduce this data structure. Based on the information contained therein, as well as user input received over the user interface (e.g., control buttons on the recording and reproducing apparatus or a remote associated with the apparatus), the controller 10 controls the drive 3 to reproduce the audio/video source packets from the optical disk. For example, the user input may specify a path to reproduce. This user input may be specified, for example, via a menu based graphical user interface preprogrammed into the controller 10. Using the user input and the path management or change information reproduced from the optical disk, the controller 10 controls the reproduction of the specified path or changing the reproduction of the specified path as described in detail above with respect to the embodiments of the present invention.

[0062] The reproduced source packets are received by a source depacketizer 4 and converted into a data stream (e.g., an MPEG-2 transport packet stream). A demultiplexer 5 demultiplexes the data stream into encoded

video and audio data. An AV decoder 6 decodes the encoded video and audio data to produce the original audio and video data that was feed to the AV encoder 9. During reproduction, the controller 10 controls the operation of the source depacketizer 4, demultiplexer 5 and AV decoder 6. The controller 10 receives user input on the reproducing operation, and provides control information to AV decoder 6, demultiplexer 5 and the source packetizer 4. For example, the controller 10 instructs the AV decoder 9 on the type of decoding to perform, instructs the demultiplexer 5 on the transport stream to demultiplex, and instructs the source depacketizer 4 on the source packet format.

[0063] While Fig. 8 has been described as a recording and reproducing apparatus, it will be understood that only a recording or only a reproducing apparatus may be provided using those portions of Fig. 7 providing the recording or reproducing function.

[0064] As apparent from the above description, the present invention provides a multiple reproduction path data stream managing method for high-density optical discs which can rapidly and accurately access to the data streams of the path designated by the user in a jumped fashion in order to reproduce the data streams, while being capable of minimizing a reduction in the recording efficiency of multi-path data streams.

[0065] As will be appreciated from the forgoing disclosure, the present invention provides a recording medium having a file or data structure that permits managing and/or controlling navigation of the reproduction of

video data on a multiple reproduction path basis. Accordingly, the present invention provides a greater level of flexibility in the reproduction of video data than previously available.

[0066] While the invention has been disclosed with respect to a limited number of embodiments, those skilled in the art, having the benefit of this disclosure, will appreciate numerous modifications and variations there from. For example, while described with respect to a Blu-ray ROM optical disk in several instances, the present invention is not limited to this standard of optical disk or to optical disks. It is intended that all such modifications and variations fall within the spirit and scope of the invention.